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METEOROLOGICAL OFFICE

London Road, Bracknell, Berkshire

CLIMATOLOGICAL MEMORANDUM

No 75

MAPS OF MEAN VAPOUR PRESSURE AND OF FREQUENCES OF HIGH RELATIVE HUMIDITY OVER THE UNITED KINGDOM

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INTRODUCTION

Values of vapour pressure and relative humidity are derived (using humidity slide-rule or tables[1]) from dry- and wet-bulb temperatures measured in louvred screens mounted with the thermometer bulbs 1.22 m above the ground.

VAPOUR PRESSURE

The vapour pressure is that part of the total atmospheric pressure which is exerted by water vapour.

Maps of monthly and annual mean vapour pressure at 15 GMT over the period 1941-70 were constructed using data from about 38 stations with records extending over the full period, and from an additional 37 stations with records covering shorter periods.

The decision to map vapour pressure at 15 GMT, rather than at other times of day, arose from consideration of the normal pattern of diurnal variation; this is shown in figure 1a, which presents average values of vapour pressure through the day for four stations over the period 1957-70. The average diurnal variation is not large, but can be explained in terms of the evaporation and deposition of dew. The highest rate of rise of vapour pressure occurs when dew evaporates after sunrise, and so the time of this rise varies through the year. After the morning rise, the vapour pressure remains fairly constant during the day and then falls gradually through the night as dew is again deposited. Thus the time at which vapour pressure is most stable in all months of the year is 15 GMT, and so this has been adopted as the standard time for mapping.

Because of the sparseness of the observing network, it was not possible to identify any consistent variation of average vapour pressure with altitude below 200m above mean sea level. Therefore no altitude correction was applied to the calculated values before the isopleths were drawn, and the analysed maps may be taken as broadly representative of conditions below 200m. However, there is some evidence for a variation of vapour pressure with height above 200m. Comparison of data from Great Dunn Fell, Cumbria (857m) with those from stations at about 200m in the same general area indicated a variation with altitude above 200m of about 0.15 mb per 100m. If estimates are required for sites above 200m, it is suggested that a correction of this magnitude be subtracted from the map values. Monthly and annual means of vapour pressure at 03, 09, 15 and 21 GMT for the period 1961-70 for a number of places in the United Kingdom will be published shortly.[2] The year-to-year variation of monthly average vapour pressure over the period 1941-70 is shown for the four mid-season months at four stations in figure 2.

RELATIVE HUMIDITY

Relative humidity is the ratio, expressed as a percentage, of the vapour pressure of the air to the saturated vapour pressure with respect to water at the same temperature. As the saturated vapour pressure increases sharply with increasing temperature, it is to be expected that average relative humidities will display a marked diurnal variation, falling to a minimum value as temperatures rise to a maximum in the middle of the day. This is clearly evident in the average diurnal variation of relative humidity at 4 stations over the period 1957-70 which are presented in figure 1b.

In the light of the large variations in relative humidity from hour to hour, tabulation of average values at a particular time of day have only very limited value. On the other hand, there is considerable interest in the periods of time during which the relative humidity exceeds certain threshold values. Therefore the maps presented in this Memorandum were drawn to show the percentages of time during the period 1961-70 when the relative humidity was equal to or greater than 80%, 90%, 95% and 99%. They are based on observations from 23 stations recording hourly data during 1961-70 supplemented by data from a further 13 stations which recorded at 03, 09, 15 and 21 GMT. Frequencies from the latter group of stations were multiplied by 6 to give a close approximation to the frequencies derived from 24 hourly values. Additional information from the period 1957-66 was available from 28 stations and was used after slight adjustments had been made following a comparison of the different periods.

The dependence of relative humidity on altitude is very marked, and there is an apparent increase of approximately 6% of time per 100m for all four humidity thresholds due to the increased incidence of hill fog (low stratus cloud) at higher levels. As a consequence of the loss of atmospheric moisture by condensation and precipitation over high ground, humidities to the lee of hills tend to be lower than those at the same level on the windward side. Since the main moisture-bearing winds over the UK are the prevailing south-westerlies, this means that areas with low frequencies of high humidity are to be found to the east of high ground.

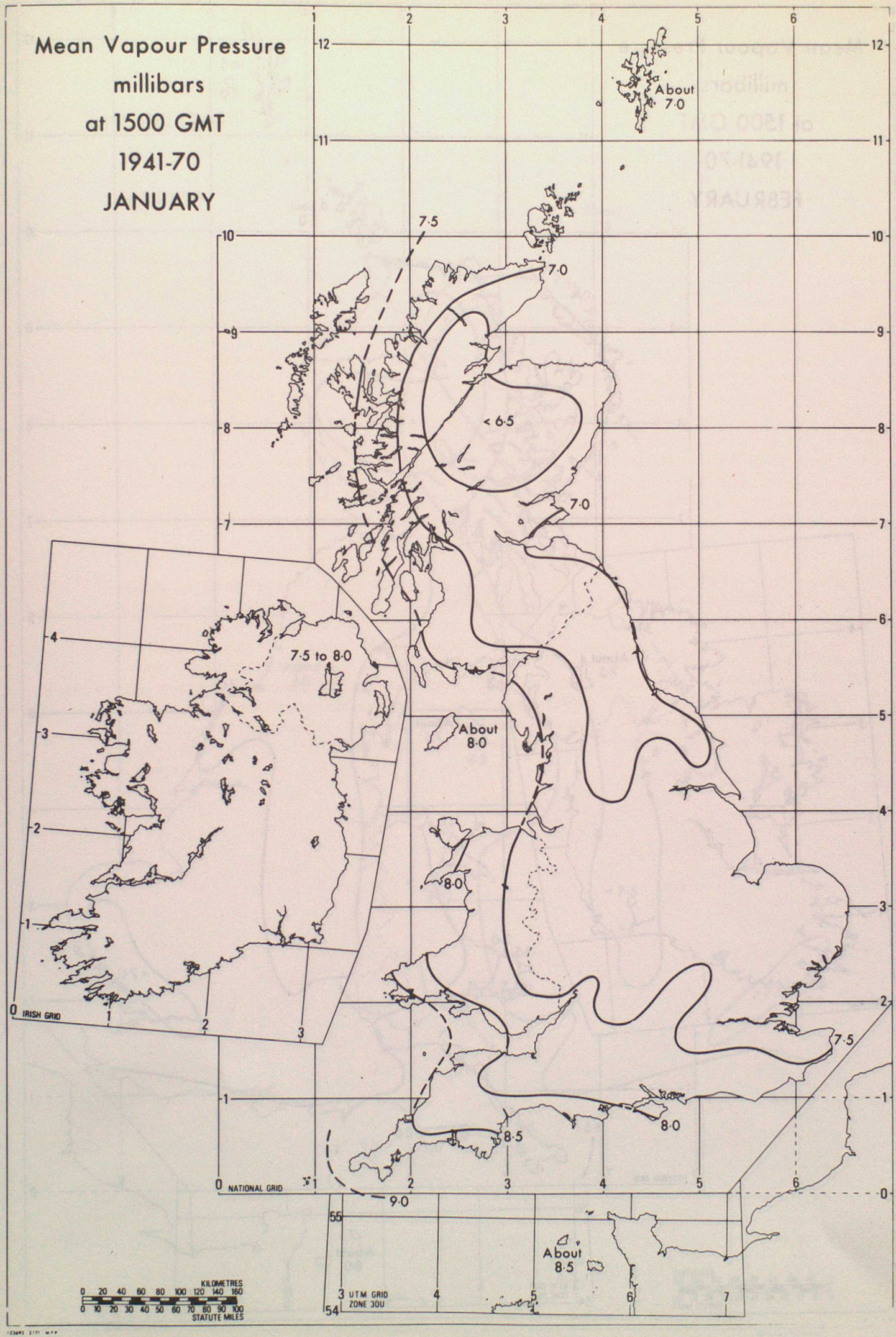
Although data from 64 stations in all were used, the sparseness of data coverage, particularly over Scotland, made the drawing of the maps rather subjective. In particular, the paucity of data from high level sites means that values shown in mountainous areas should be considered approximate. Moreover, maps of the scale presented here cannot show local effects such as might arise from fogs in low-lying valleys.

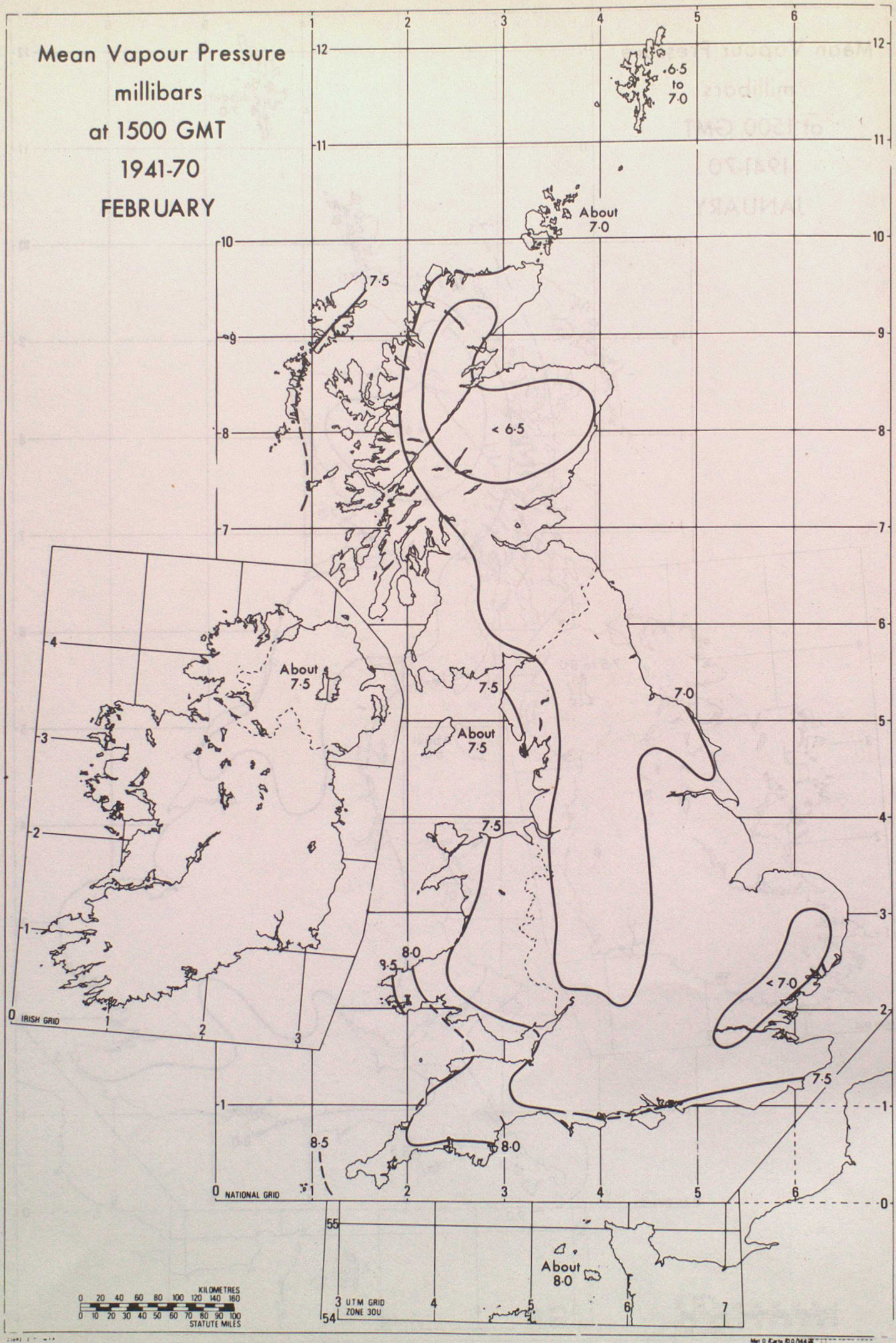
It should be noted that, by contrast with the maps of vapour pressure, the relative humidity maps are intended to apply broadly to the terrain of the area; altitude effects have been incorporated in the analysis, and so no additional height correction to the map values is necessary to obtain local estimates.

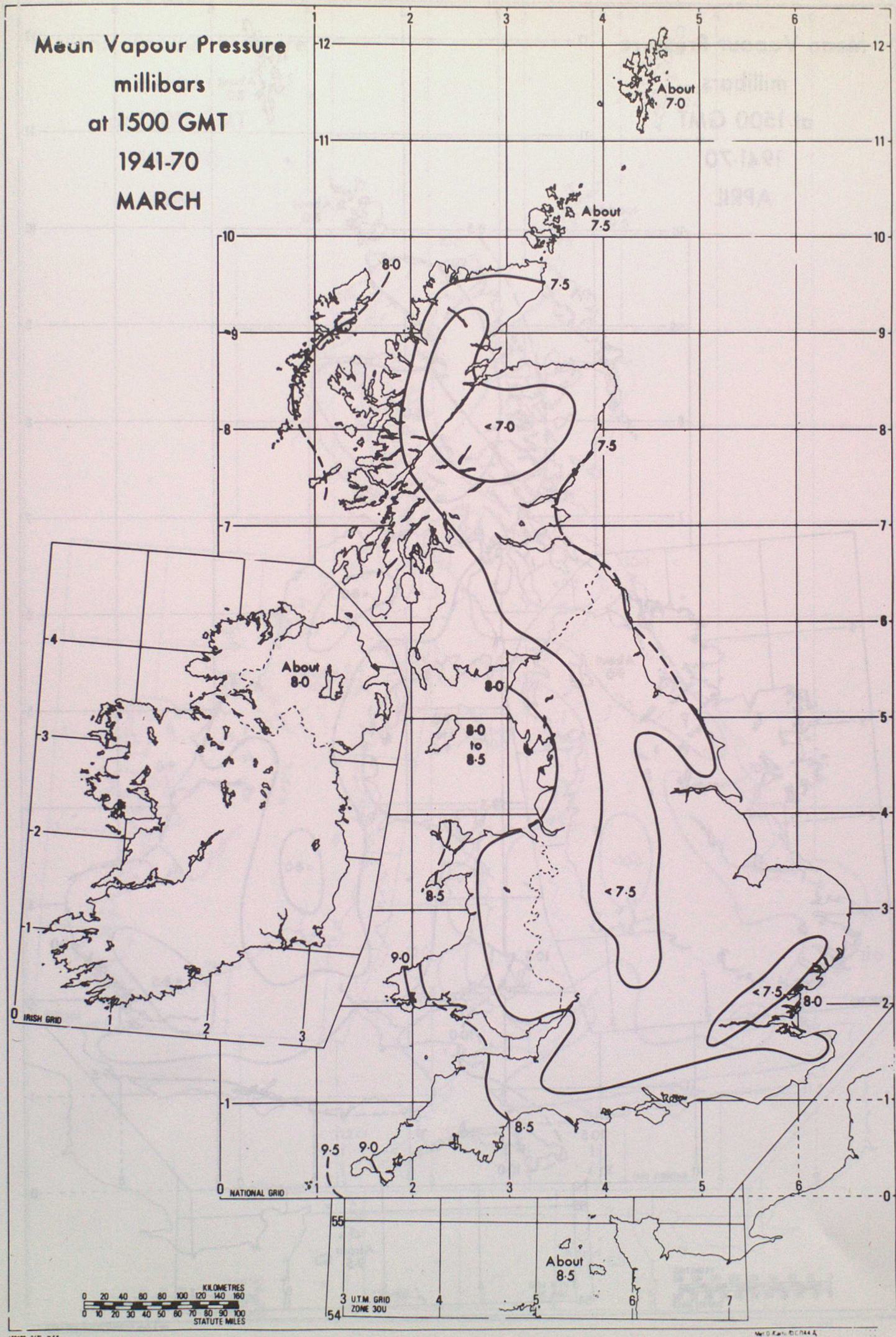
References

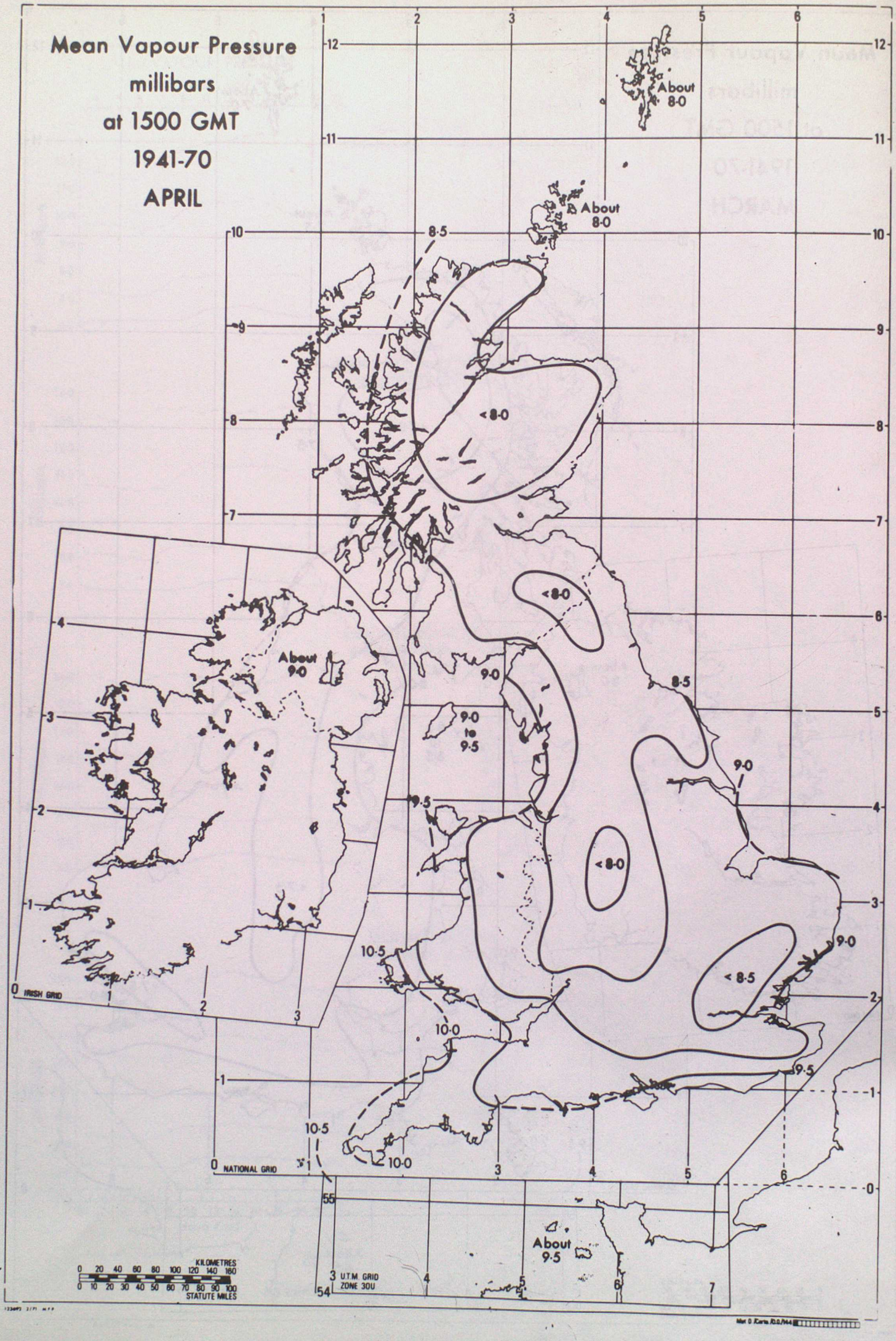
1. Hygrometric Tables (Parts I, II and III) Met O 265 a, b, c HMSO (1964)

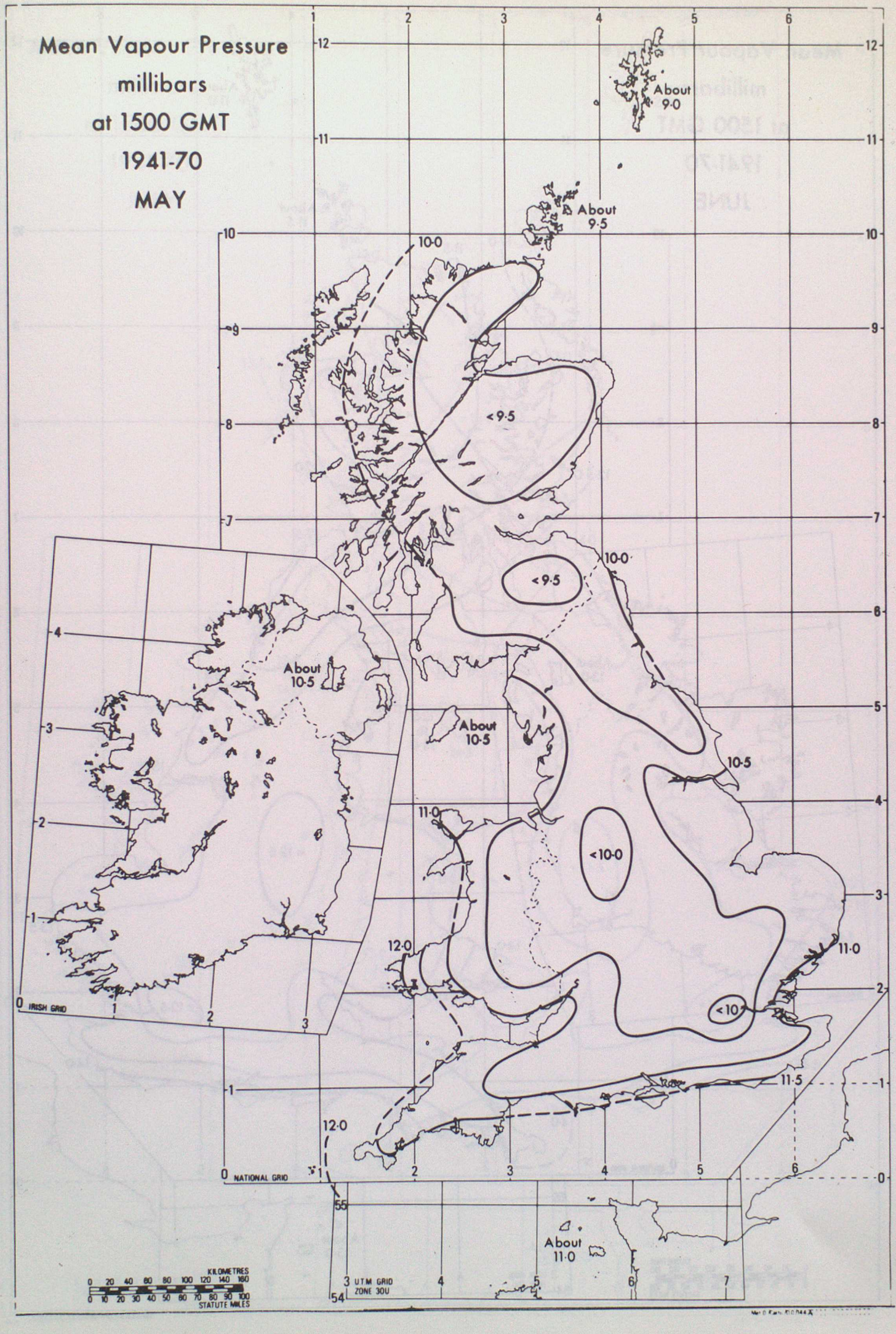
2. Averages of Humidity over the United Kingdom 1961-70 (to be published)

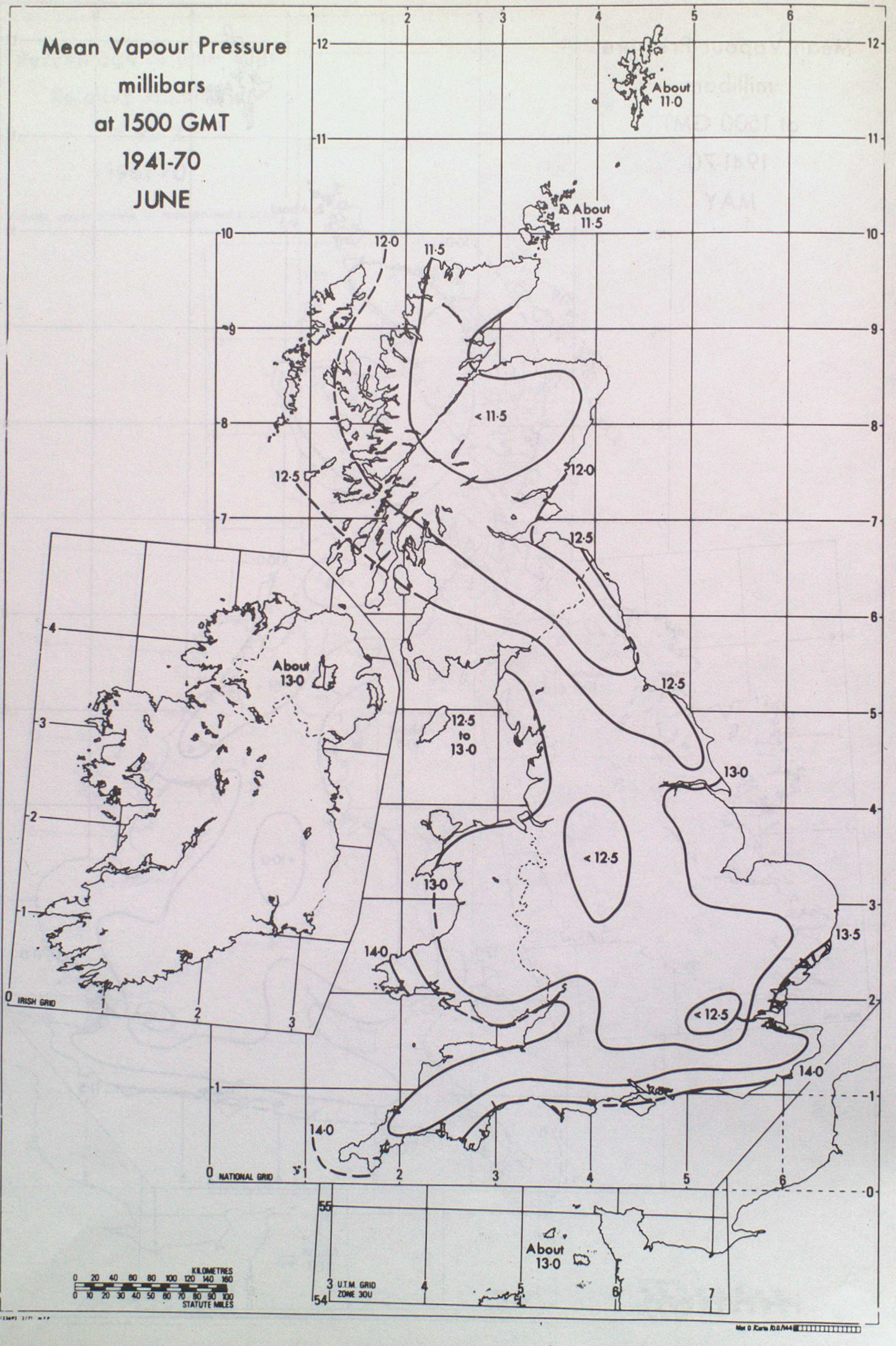

Mean Vapour Pressure
millibars
at 1500 GMT
1941-70
JANUARY
About 7·0
7·5
7·0
< 6·5
7·0
7·5 to 8·0
About 8·0
8·0
7·5
8·0
8·5
9·0
About 8·5
IRISH GRID
NATIONAL GRID
UTM GRID ZONE 30U
KILOMETRES
0 20 40 60 80 100 120 140 160
0 10 20 30 40 50 60 70 80 90 100
STATUTE MILES


Mean Vapour Pressure
millibars
at 1500 GMT
1941-70
FEBRUARY
6·5 to 7·0
About 7·0
7·5
< 6·5
About 7·5
7·5
7·0
About 7·5
7·5
8·0
9·5
< 7·0
7·5
8·5
8·0
About 8·0
IRISH GRID
NATIONAL GRID
UTM GRID ZONE 30U
KILOMETRES
0 20 40 60 80 100 120 140 160
STATUTE MILES
0 10 20 30 40 50 60 70 80 90 100

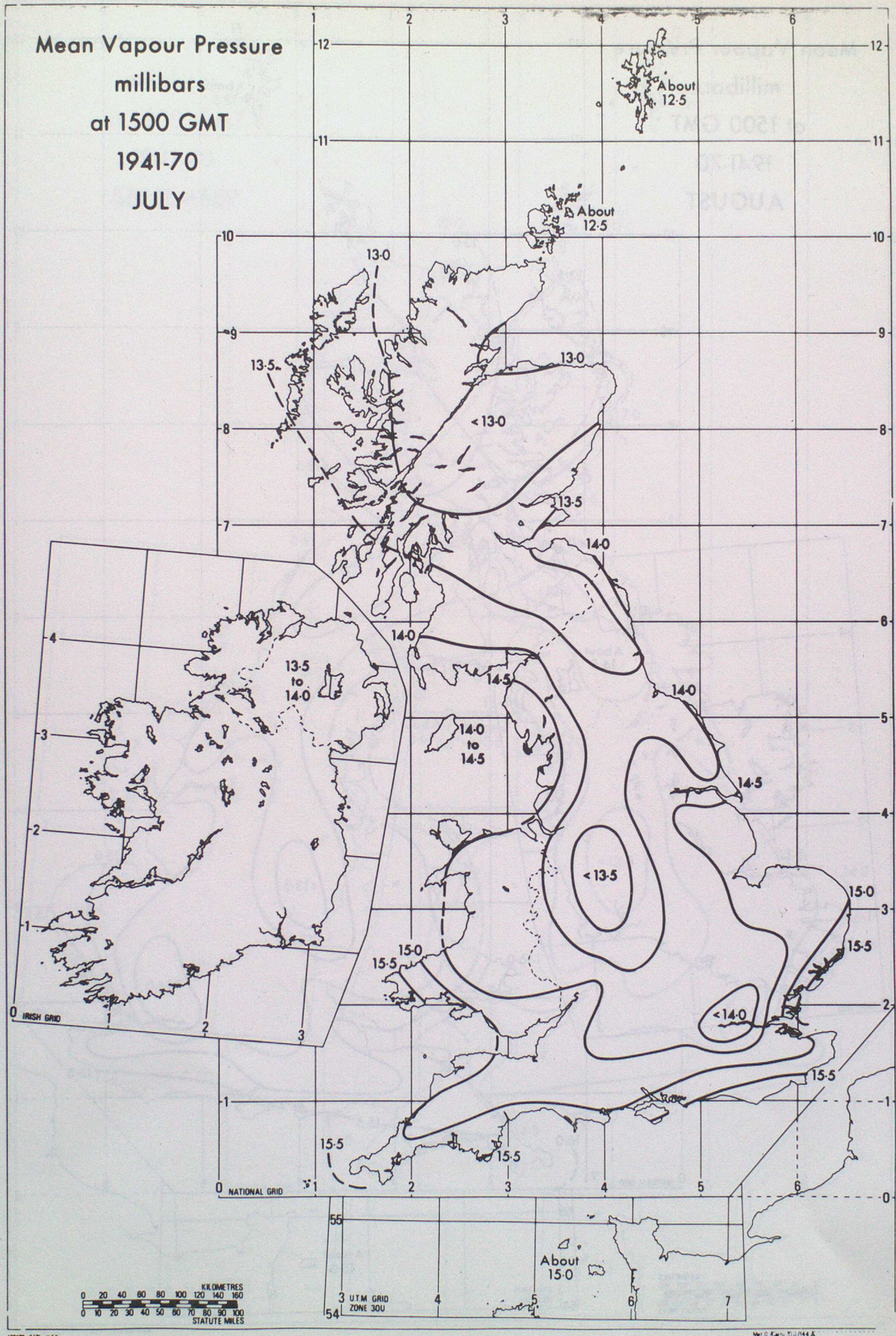

Mean Vapour Pressure
millibars
at 1500 GMT
1941-70
MARCH
About 7·0
About 7·5
8·0
7·5
<7·0
7·5
About 8·0
8·0
8·0 to 8·5
8·5
<7·5
9·0
<7·5
8·0
8·5
9·5
9·0
About 8·5
IRISH GRID
NATIONAL GRID
U.T.M. GRID ZONE 30U
KILOMETRES
0 20 40 60 80 100 120 140 160
0 10 20 30 40 50 60 70 80 90 100
STATUTE MILES


Mean Vapour Pressure
millibars
at 1500 GMT
1941-70
APRIL
About 8·0
About 8·0
<8·0
<8·0
About 9·0
9·0
9·0 to 9·5
8·5
9·0
9·5
<8·0
10·5
<8·5
9·0
10·0
9·5
10·5
10·0
About 9·5
IRISH GRID
NATIONAL GRID
U.T.M. GRID ZONE 30U
KILOMETRES
0 20 40 60 80 100 120 140 160
0 10 20 30 40 50 60 70 80 90 100
STATUTE MILES

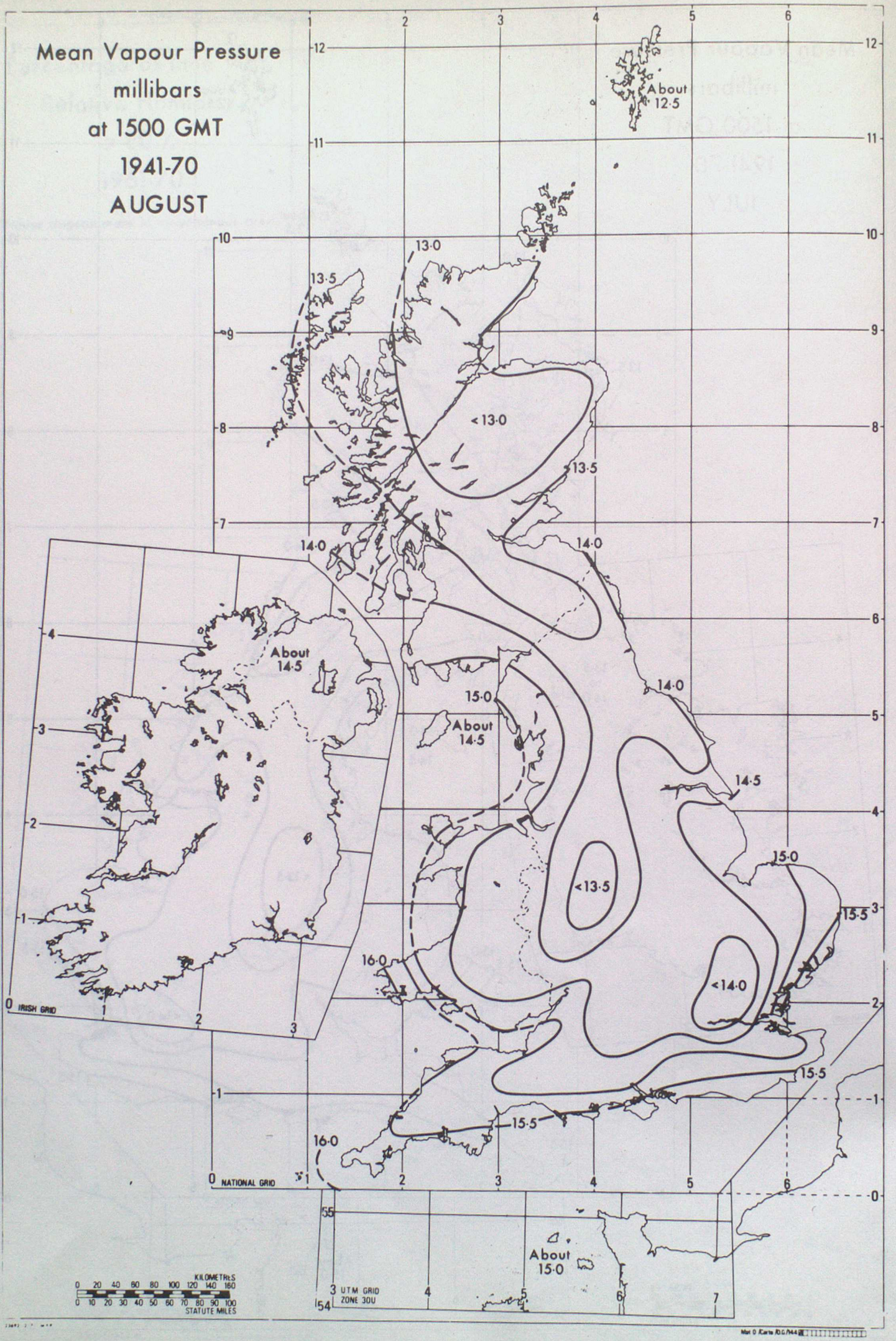

Mean Vapour Pressure
millibars
at 1500 GMT
1941-70
MAY
About 9·0
About 9·5
10·0
<9·5
<9·5
10·0
About 10·5
About 10·5
10·5
11·0
<10·0
12·0
11·0
<10
11·5
12·0
About 11·0
IRISH GRID
NATIONAL GRID
UTM GRID ZONE 30U
KILOMETRES
STATUTE MILES


Mean Vapour Pressure
millibars
at 1500 GMT
1941-70
JUNE
About 11·0
About 11·5
12·0
11·5
< 11·5
12·5
12·0
12·5
About 13·0
12·5 to 13·0
12·5
13·0
< 12·5
13·0
14·0
13·5
< 12·5
14·0
14·0
IRISH GRID
NATIONAL GRID
About 13·0
U.T.M. GRID ZONE 30U
KILOMETRES
0 20 40 60 80 100 120 140 160
0 10 20 30 40 50 60 70 80 90 100
STATUTE MILES

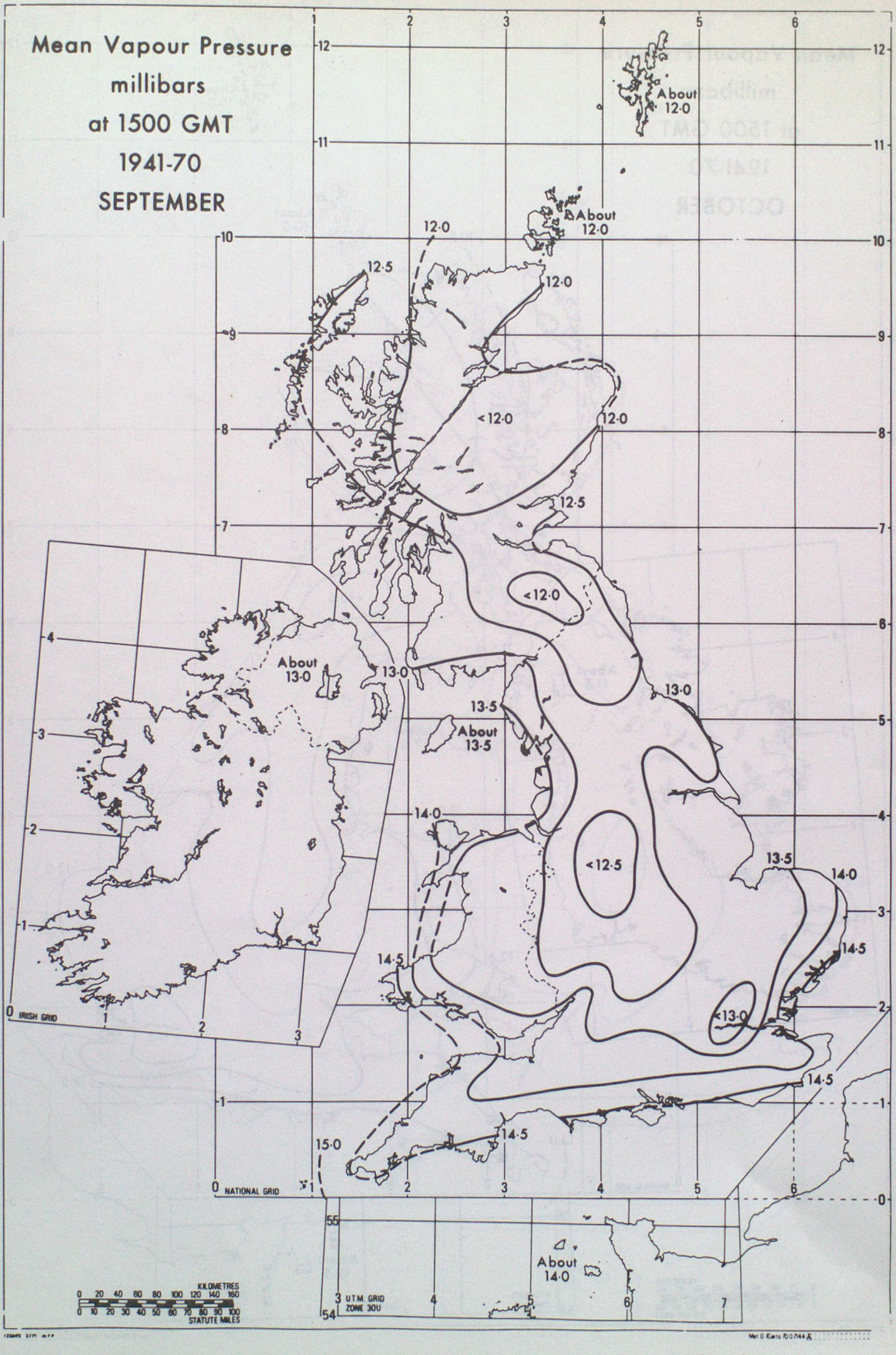
Mean Vapour Pressure millibars at 1500 GMT 1941-70 JULY

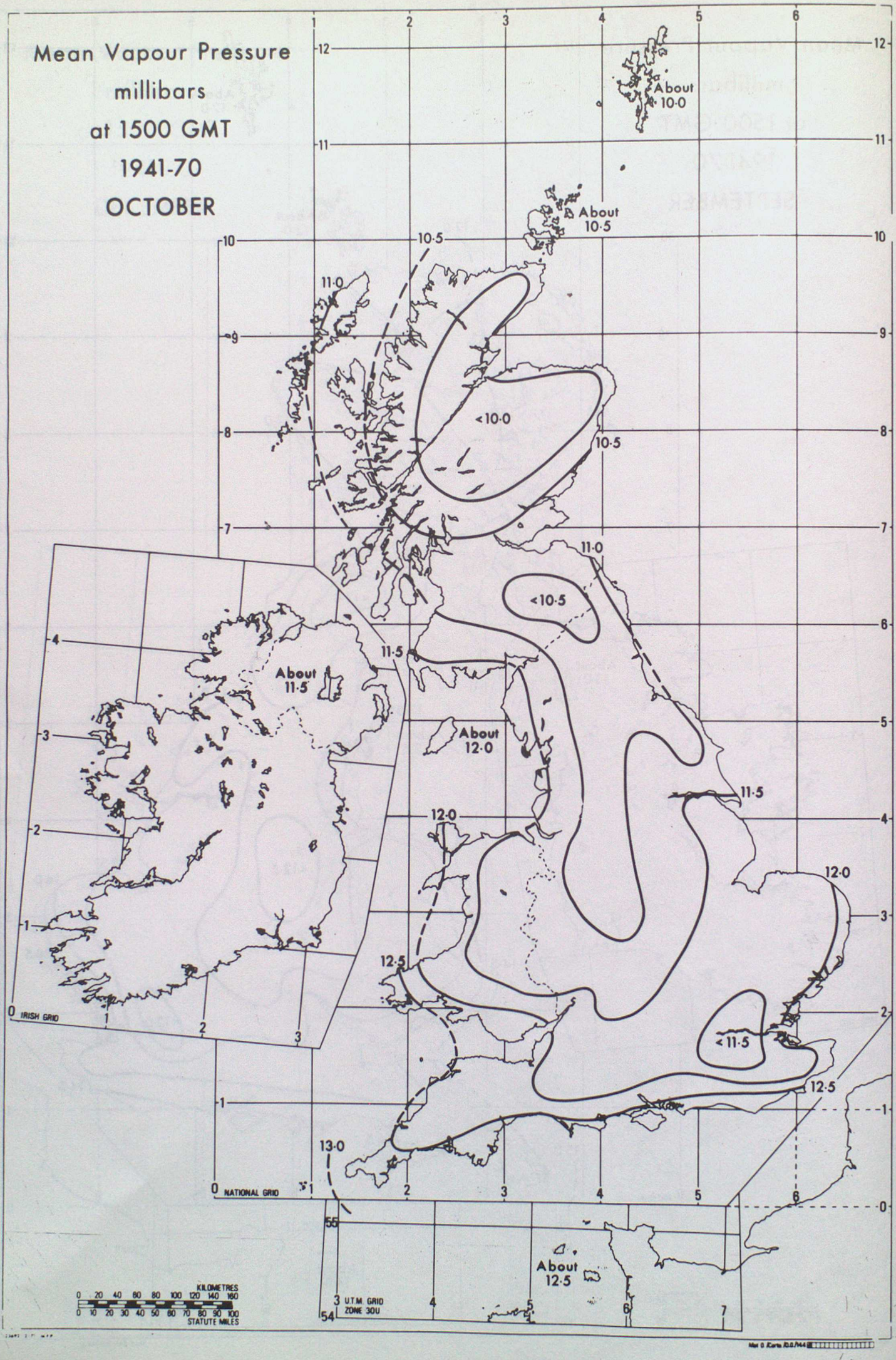


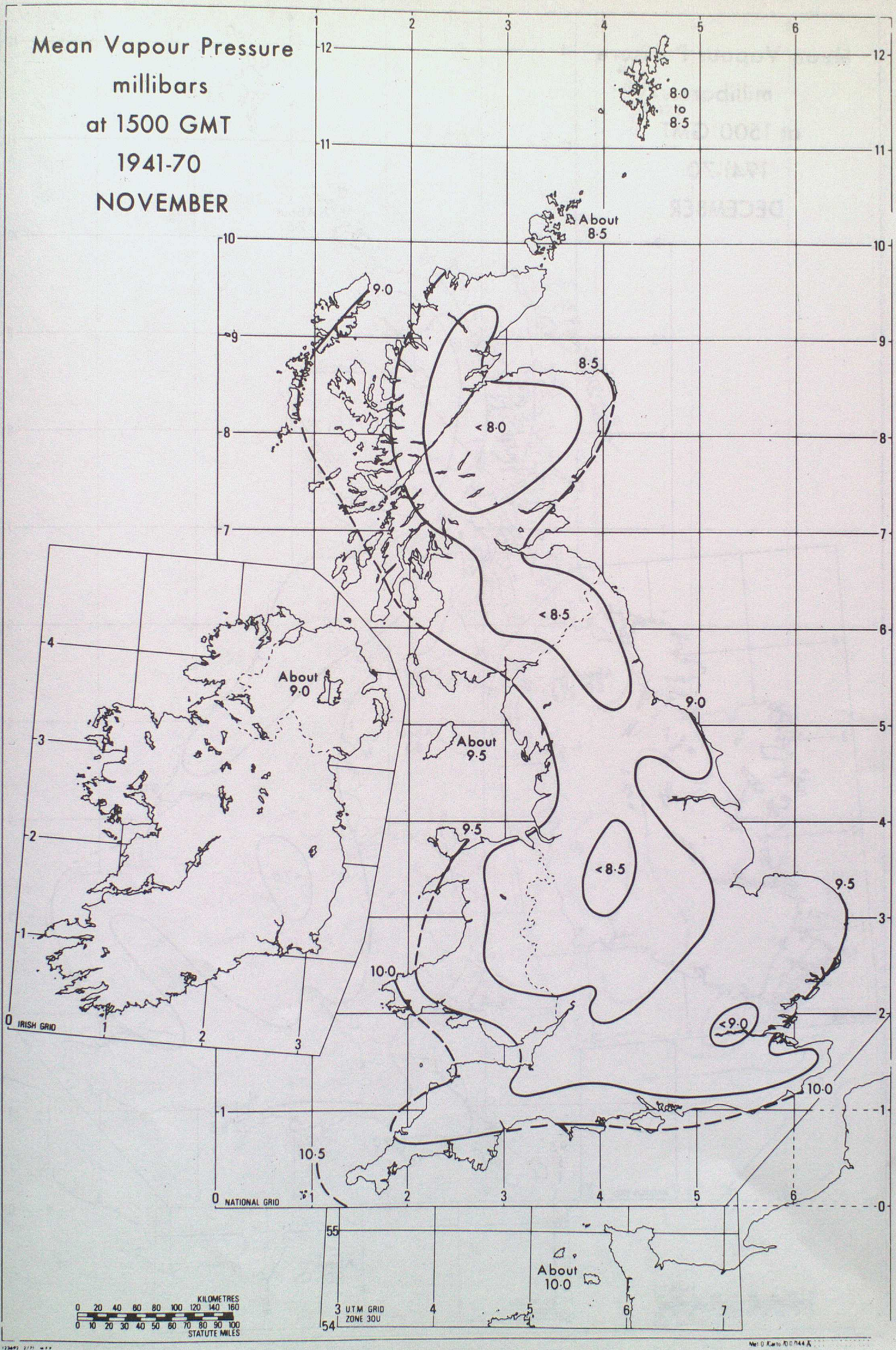
Mean Vapour Pressure millibars at 1500 GMT 1941-70 AUGUST

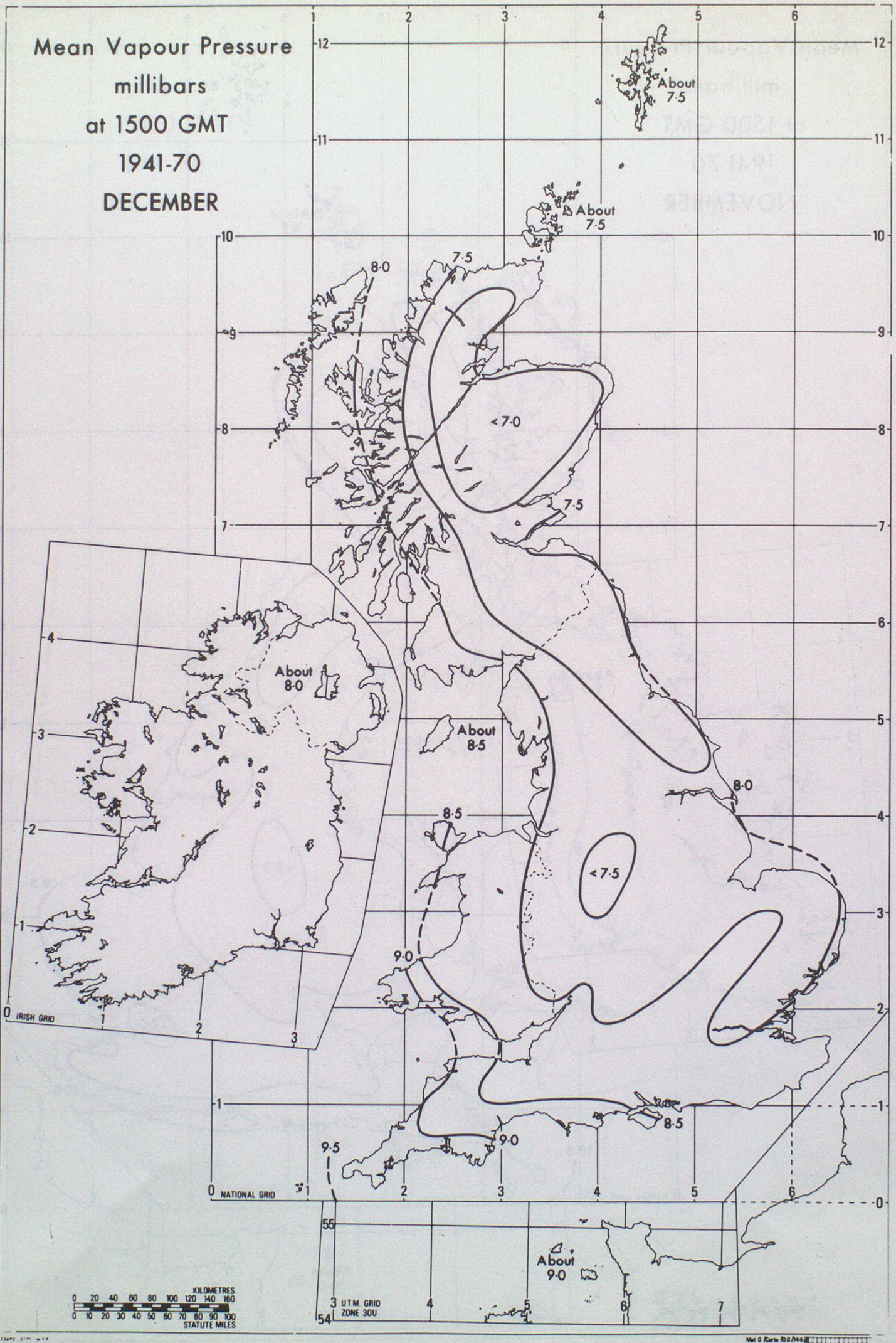


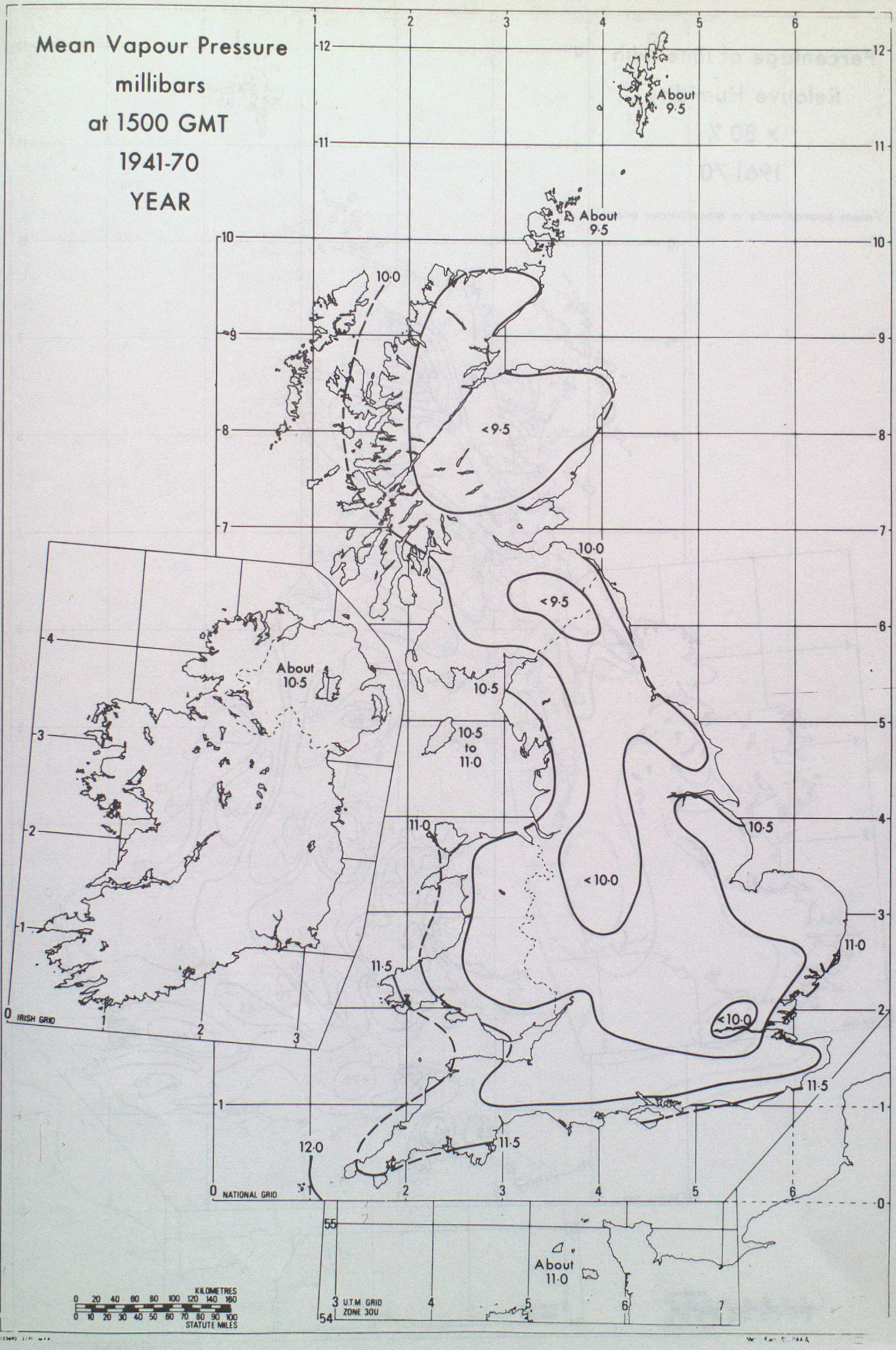
Mean Vapour Pressure millibars at 1500 GMT 1941-70 SEPTEMBER

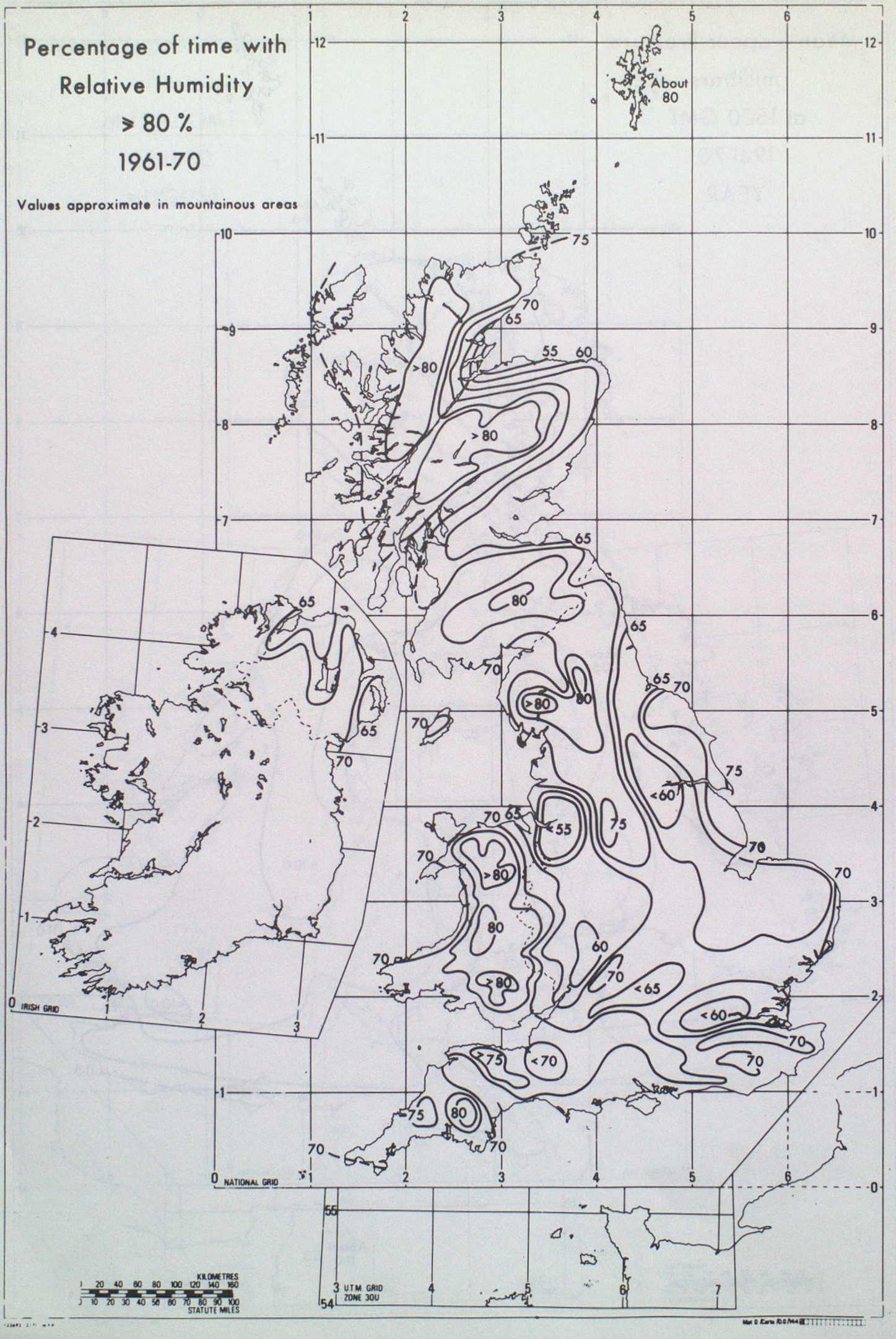



Mean Vapour Pressure
millibars
at 1500 GMT
1941-70
OCTOBER
About
10·0
About
10·5
10·5
11·0
<10·0
10·5
11·0
<10·5
11·5
About
11·5
About
12·0
11·5
12·0
12·0
12·5
<11·5
12·5
13·0
About
12·5
IRISH GRID
NATIONAL GRID
U.T.M. GRID
ZONE 30U
KILOMETRES
0 20 40 60 80 100 120 140 160
0 10 20 30 40 50 60 70 80 90 100
STATUTE MILES


Mean Vapour Pressure
millibars
at 1500 GMT
1941-70
NOVEMBER
8·0
to
8·5
About
8·5
9·0
8·5
< 8·0
< 8·5
About
9·0
About
9·5
9·0
9·5
< 8·5
9·5
10·0
< 9·0
10·0
10·5
About
10·0
IRISH GRID
NATIONAL GRID
UTM GRID
ZONE 30U
KILOMETRES
0 20 40 60 80 100 120 140 160
0 10 20 30 40 50 60 70 80 90 100
STATUTE MILES


Mean Vapour Pressure
millibars
at 1500 GMT
1941-70
DECEMBER
About 7·5
About 7·5
8·0
7·5
<7·0
7·5
About 8·0
About 8·5
8·0
8·5
<7·5
9·0
8·5
9·5
9·0
About 9·0
IRISH GRID
NATIONAL GRID
UTM GRID ZONE 30U
KILOMETRES
0 20 40 60 80 100 120 140 160
0 10 20 30 40 50 60 70 80 90 100
STATUTE MILES

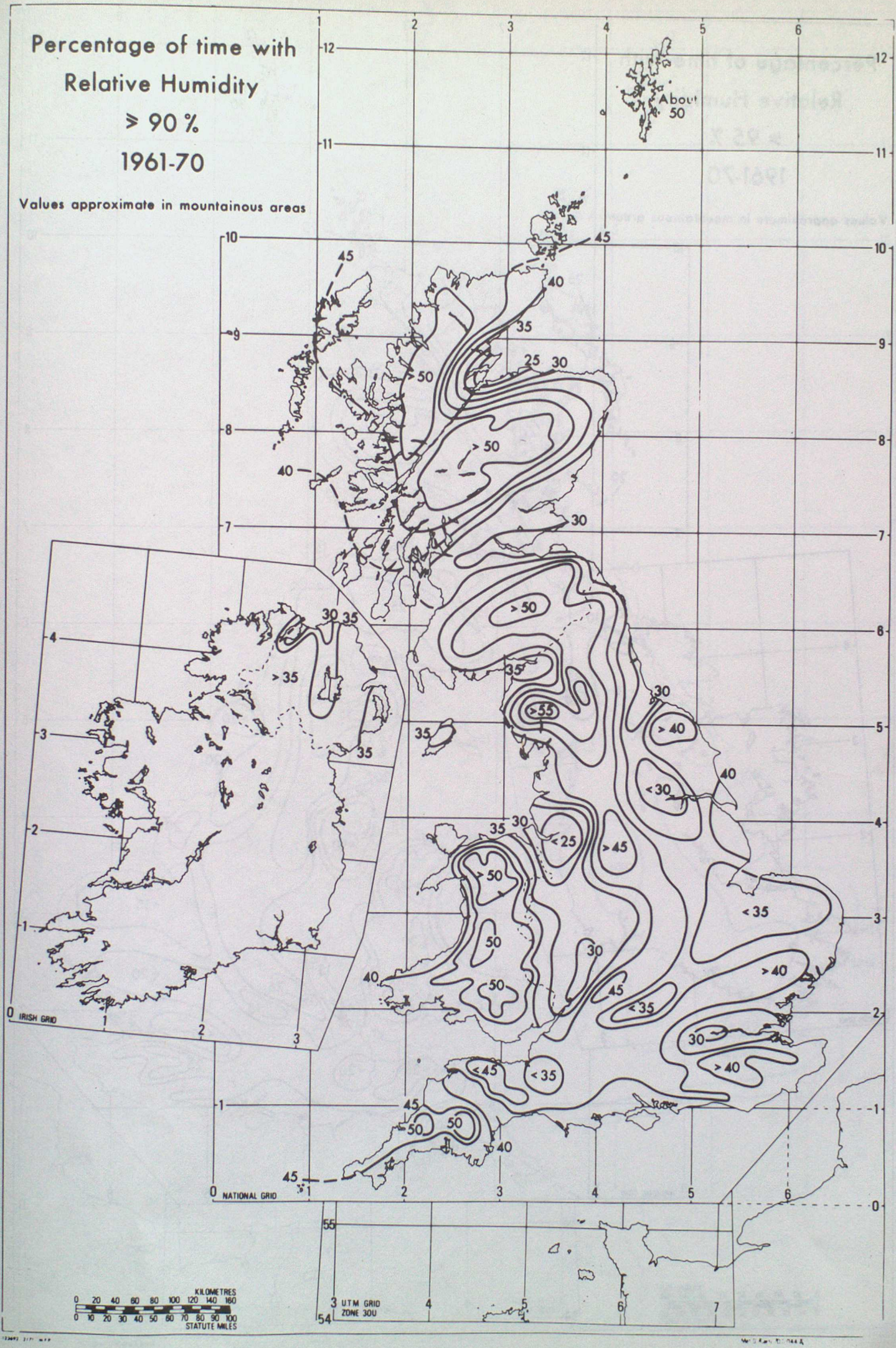

Mean Vapour Pressure
millibars
at 1500 GMT
1941-70
YEAR
About 9·5
About 9·5
10·0
<9·5
10·0
<9·5
About 10·5
10·5
10·5 to 11·0
11·0
10·5
<10·0
11·0
11·5
<10·0
11·5
12·0
11·5
About 11·0
IRISH GRID
NATIONAL GRID
UTM GRID ZONE 30U
KILOMETRES
0 20 40 60 80 100 120 140 160
0 10 20 30 40 50 60 70 80 90 100
STATUTE MILES


Percentage of time with
Relative Humidity
≥ 80 %
1961-70
Values approximate in mountainous areas
About 80
IRISH GRID
NATIONAL GRID
UTM GRID ZONE 30U
KILOMETRES
STATUTE MILES

Percentage of time with Relative Humidity ⩾ 90 %

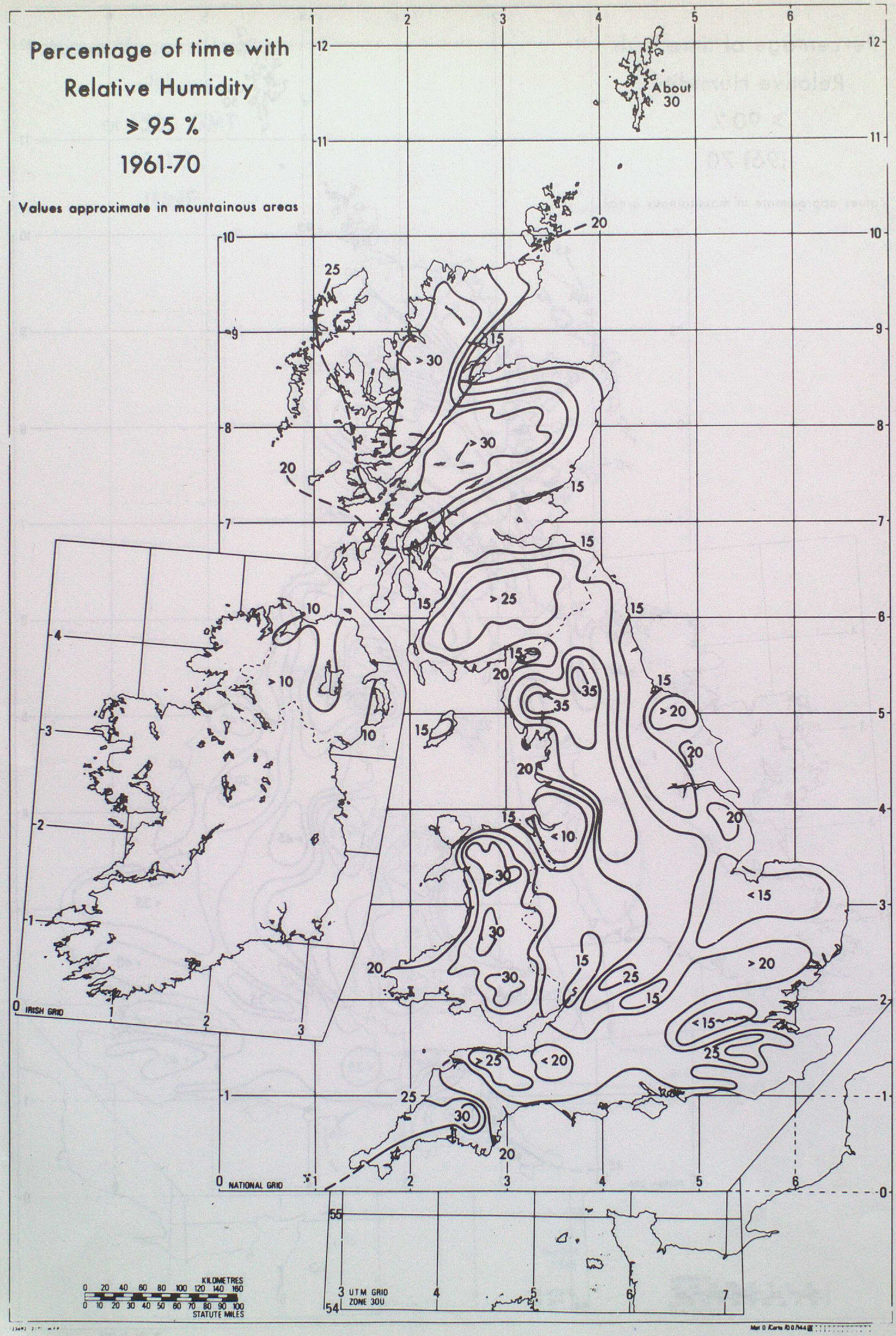
1961-70

Values approximate in mountainous areas



Percentage of time with Relative Humidity ⩾ 95 % 1961-70

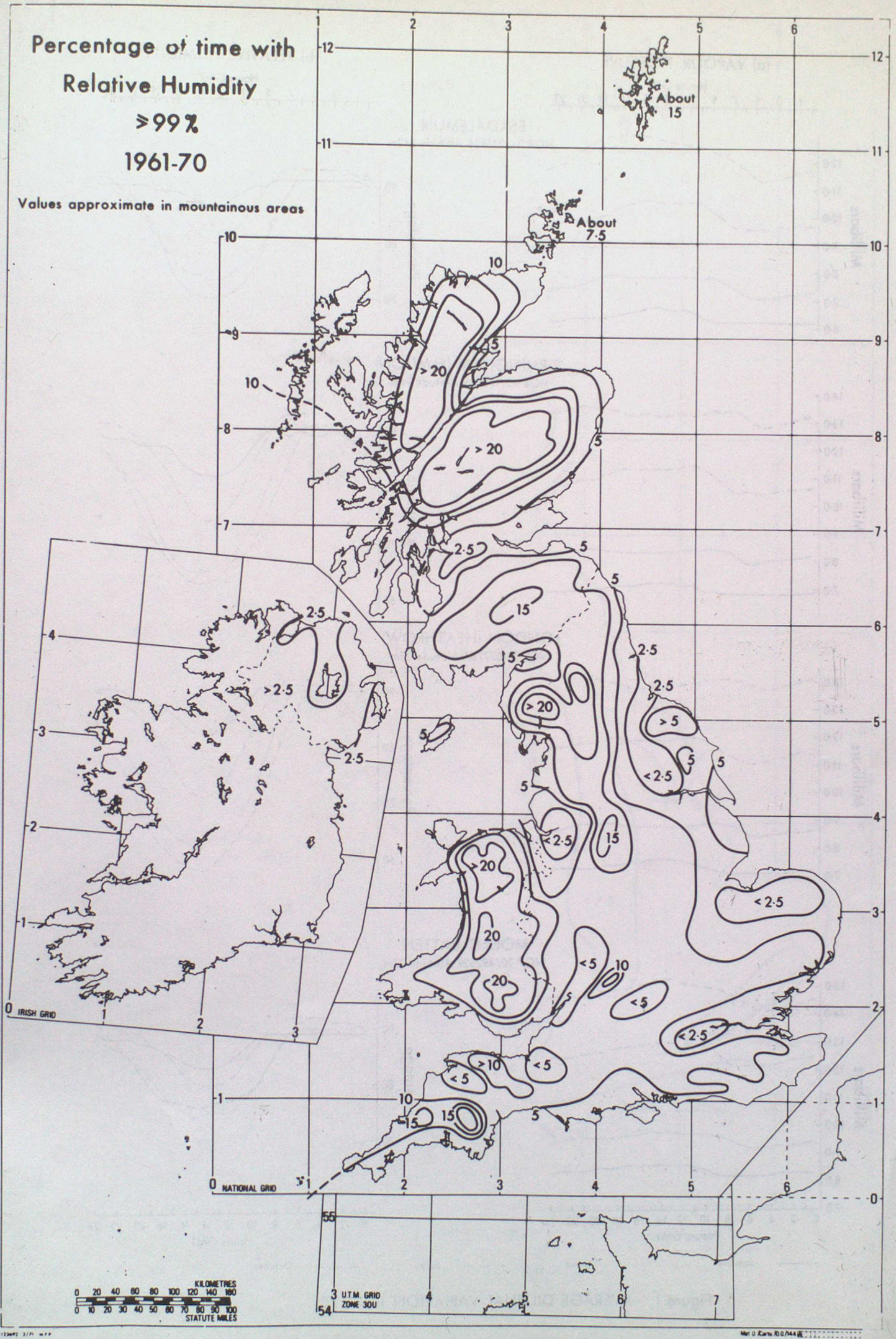
Values approximate in mountainous areas



Percentage of time with Relative Humidity ≥99%

1961-70

Values approximate in mountainous areas



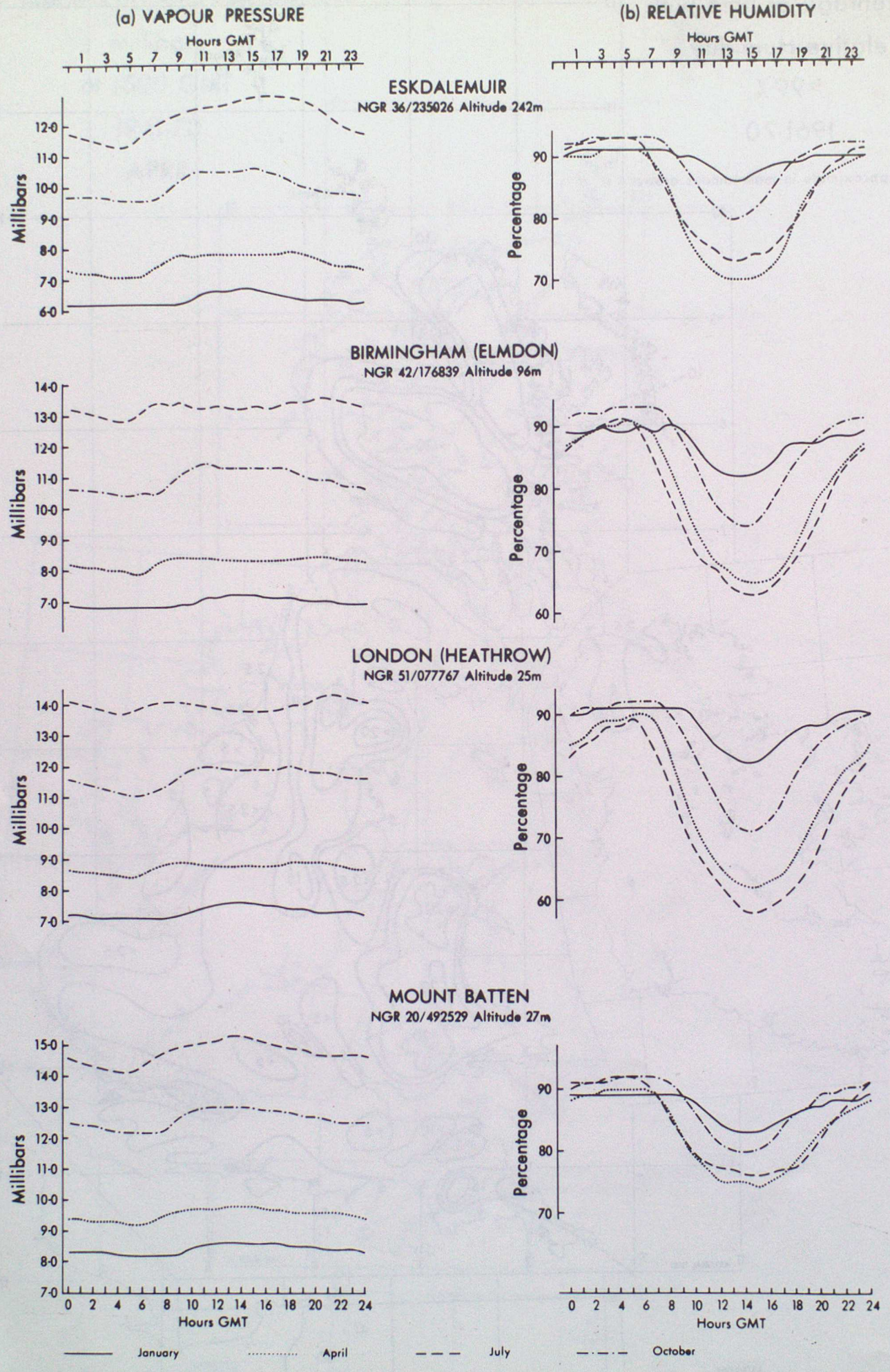


Figure 1 AVERAGE DIURNAL VARIATION 1957—70

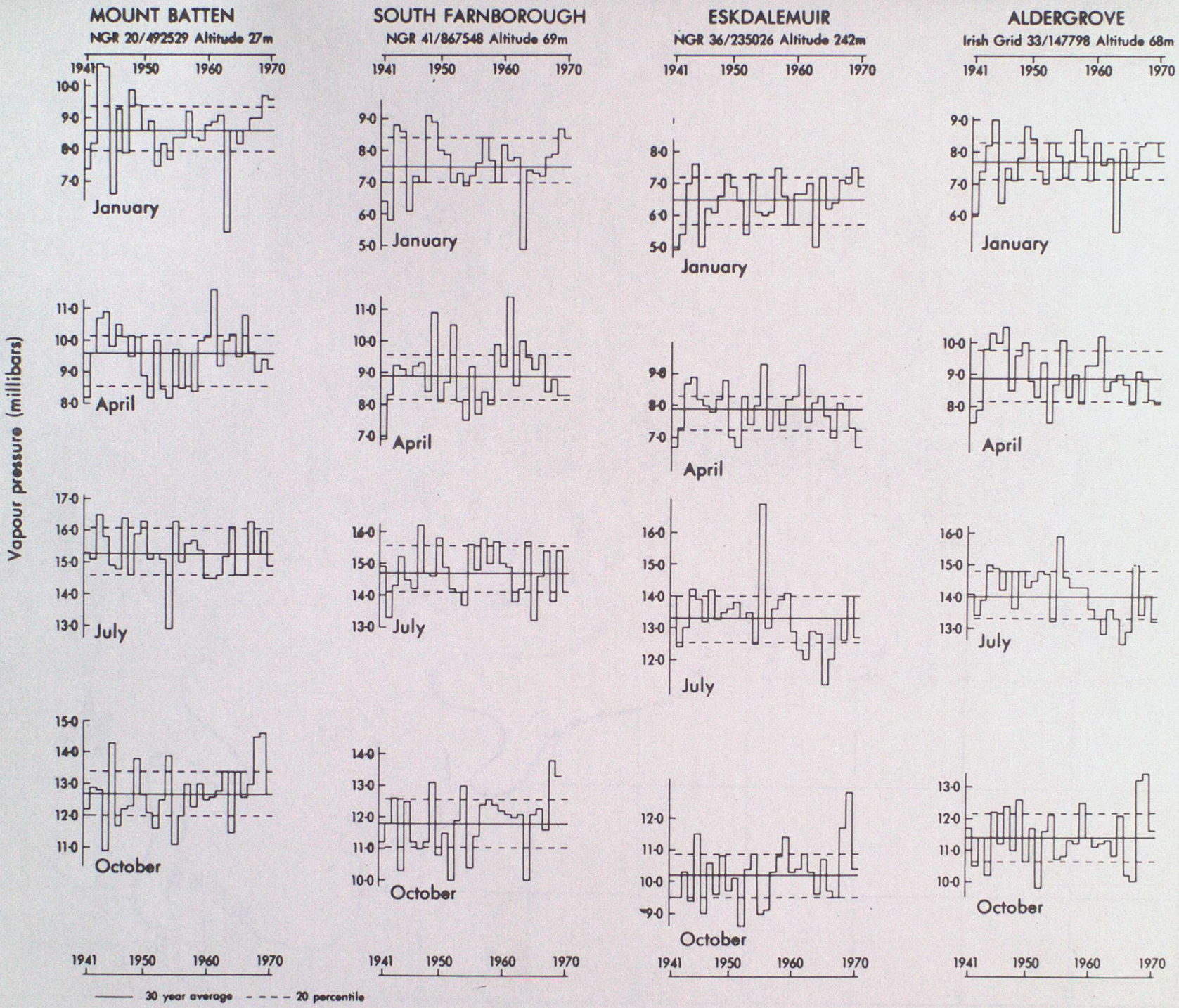


Figure 2 YEAR TO YEAR VARIATION OF MEAN VAPOUR PRESSURE AT 15 GMT 1941—1970